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News of the Week

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Cover: Vanillin crystal photographed with cross-polarized filters. Photo courtesy of Givaudan

Business

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SUPERFUND REWRITE: Firms say House bill tax outrageous

As a major rewrite and expansion of the Superfund law sped toward a House vote in early August, large and small firms in the chemical industry went before the House Ways & Means Committee to plead the case that the feedstock taxes contained in the bill were so high as to be self-defeating.

The chemical industry, its witnesses emphasized, does believe that Superfund should be continued beyond its Sept. 30, 1985, expiration date. And it believes that abandoned dump sites that pose hazards to human health or the environment should be identified and cleaned up. The bill containing the Superfund rewrite, H.R. 5640, seeks to raise $9 billion over five years from industry taxes, compared to the current $1.6 billion over five years.

These amounts are "exceedingly high," says Robert D. Kennedy, Union Carbide executive vice president, and "are likely to have very serious—devastating may not be too strong a word—consequences for the basic petrochemical industry in the U.S." He points out that production of the 11 primary petrochemicals subject to the Superfund tax involved a net loss of $400 million in 1982 and barely broke even in 1983, yet also paid $158 million a year in Superfund taxes. Over the next several years, Superfund taxes, at the rate imposed in the bill, will equal 30 to 100% of the prospective earnings in primary petrochemicals, Kennedy says.

In addition to "general anguish" over the level of taxes imposed in the bill, Kennedy says, the company is concerned about the individual taxes on certain feedstocks. These, he says, do not appear to have any rational or even discernible relationships to the price of the feedstock, to its competitive situation in the marketplace, or to the hazardous products that may be the result of its production, use, or disposal. Apparently, he says, the specific tax rates for each substance on the list were developed by guessing at a 1986 sales price for each substance and setting the tax rate, in dollars per ton, at 3% of this estimated price, but not higher than $29.87 per ton for organic materials and $14.94 for inorganic materials.

But this doesn't always hold true. For example, ethylene, under H.R. 5640, would be subject to a tax of $17.71 per ton, an effective tax rate of 4.5% of its present price and 4% of the estimate of its 1986 price of $440 per ton. Yet the bill would impose a tax rate of $1.44 per ton on uranium oxide appparently, Kennedy says, based on 3% of an estimated sales price of $47.90. Although that is a very high price for uranium oxide, he points out that that is a price per pound, not a price per ton. The average current price for uranium oxide is about $38 per lb, or about $76,000 per ton. Thus, if the rationale of the drafters of the bill were uniformly applied, the tax rate for uranium oxide should be the ceiling price for inorganic substances.

The Synthetic Organic Chemical Manufacturers Association is con-

Bill would raise tax on some chemicals 500%

Tax per ton	1984	House bill
Acetylene	$4.87	$29.87
Aluminum	—	1.53
Ammonia	2.64	7.44
Antimony	4.45	14.94
Antimony trioxide	3.75	14.94
Arsenic	4.45	14.94
Arsenic trioxide	3.41	14.94
Asbestos	—	13.92
Barium sulfide	2.30	14.94
Benzene	4.87	14.88
Boron trioxide	—	14.88
Bromine	4.45	2.88
Butadiene	4.87	14.94
Butane	4.87	14.94
Butylene	4.87	24.80
Cadmium	4.45	7.09
Chlorine	2.70	9.92
Chromite	1.54	14.94
Chromium	4.45	5.67
Coal tars	—	2.55
Cobalt	4.45	14.94
Cupric oxide	3.59	10.63
Cupric sulfate	1.87	3.93
Cuprous oxide	3.97	14.94
Ethylene	4.87	14.88
Hydrochloric acid	0.29	14.88
Hydrogen fluoride	4.23	14.88
Lead oxide	4.14	17.71
Lithium carbonate	—	0.34
Manganese	—	14.94
Mercury	4.45	14.94
Methane	3.44	14.94
Naphthalene	4.87	2.77
Nickel	4.45	14.94
Nitric acid	0.24	0.28
Phosphoric acid	—	0.30
Phosphorus	4.45	14.94
Potassium dichromate	1.69	14.94
Potassium hydroxide	0.22	0.26
Propylene	4.87	13.82
Selenium	—	14.94
Sodium dichromate	1.87	14.94
Sodium hydroxide	0.28	0.33
Stannic chloride	2.12	14.94
Stannous chloride	2.85	14.94
Sulfuric acid	0.26	0.31
Toluene	4.87	12.75
Uranium oxide	—	1.44
Vanadium	—	2.48
Xylene	4.87	13.11
Zinc	—	14.94

cerned not only about the high tax rates on feedstocks to member companies but also about the new waste-end tax that would be imposed by the bill.

The waste-end tax is based on "wet-weight." This formula, says SOCMA executive director Ronald A. Lang, would treat the generator of highly concentrated toxic waste in the same fashion as a generator that has a very small quantity of such toxics in an immense volume of water. The latter in effect would be paying taxes primarily on the water. "I cannot believe," Lang says, "that this is the intent of the authors." An easy way out of this dilemma, he suggests, would be to establish a higher tax rate based on the dry weight of the hazardous materials generated.

The Chemical Manufacturers Association had some other suggestions as to how the bill could be improved. First, make a realistic determination of what EPA's annual funding needs will be. Next derive those funds from a more broadly based taxing mechanism, although CMA does support a doubling of the present industry tax rates. Provide that funding over a five-year period so the agency's needs can be re-examined. And finally, re-enact the current law unchanged in all other respects.

If the fivefold tax rate increase is allowed, CMA chairman Edwin C. Holmer, president of Exxon Chemical, warned the committee, serious consequences will result. It could eliminate or jeopardize 30,000 industry jobs, lead to the shutting down of nearly 4 billion lb of primary petrochemical capacity and jeopardize an additional 3.5 billion lb of capacity and restrict future plant investment.

Few if any changes are likely to be made in the bill by the Ways & Means Committee even if it were sympathetic to industry's pleas. Its chairman, Rep. Dan Rostenkowski (D.-Ill.), has committed himself to having the bill ready for floor action before Congress recesses for the Republican national convention on Aug. 13. There just isn't enough time to make major changes in the bill. So the chemical industry will have to take its case to the Senate. □

Vista Chemical starts operations

Earlier this month, Vista Chemical—the successor company to Conoco Chemicals—began operating as a new company. Vista comprises most of the assets of the Conoco unit purchased from Du Pont for about $500 million by a group of investors headed by former Conoco Chemicals executives.

According to Vista, 1983 sales of $523 million for the Conoco Chemicals businesses purchased by Vista would have placed the company about 445th on the Fortune 500, had it been a publically held company at the time. Sales of this size would have placed it 58th among C&EN's ranking of the 100 largest chemical producers in the U.S.

A privately held company with headquarters in Houston, Vista is starting with a product line similar to that of Conoco Chemicals. The company has plants at Lake Charles, La., where it makes products such as ethylene, normal paraffins, vinyl chloride, long-chain alcohols, and detergent alkylates; at Aberdeen, Miss., and Oklahoma City, Okla., where it makes polyvinyl chloride resins and compounds; and at Hammond, Ind., and Balimore, where it produces detergent alkylates and derivatives.

The company employs 1500 people worldwide. They include personnel in plants involved in the purchase by Vista and some 200 staff or chemicals support people with Conoco Inc. Du Pont purchased Conoco Inc. in the fall of 1981 for $7.8 billion.

"Over 35 former Conoco Chemicals managers are members of the Vista Chemical investment group and are actively involved in day-to-day operations of the new company," says John D. Burns, president and chief executive officer of Vista and former executive vice president of Conoco Chemicals. "We are all committed to the success of Vista Chemical and are excited about the challenge and opportunity that lie ahead," he adds.

Burns also says that no substantive changes are planned for Vista's operations and product lines in the near future. "Vista Chemical will direct its efforts toward operating the existing businesses as efficiently and safely as they were under Conoco," he says.

Burns: committed to its success

Gordon A. Cain, a former Conoco vice president who, with the E. F. Hutton Group, organized the investment team, is chairman of the board of Vista. R&D operations of the new firm will use facilities leased from Conoco in Ponca City, Okla., for several years under terms of the purchase agreement.

International operations for Vista are directed through three subsidiaries. These include Vista Chemical Co. Latin America, headquarted in Houston; Vista Chemical Co. Far East, in Tokyo; and Vista Chemical Europe, in Brussels. Vista also holds partial interests in three foreign affiliates, two in Japan, and one in Argentina. □

Berkeley's Koshland named *Science* editor

Daniel E. Koshland Jr., 64-year-old professor of biochemistry at the University of California, Berkeley, has been named editor of *Science*, the weekly journal of the American Association for the Advancement of Science. He will take over the position in January 1985.

Flavors and Fragrances Industry Faces Season of Consolidation

This highly fragmented industry of many producers expects rash of acquisitions and consolidation under pressures of slowing sales growth, declining profitability, higher capital and R&D funding

Patricia L. Layman, C&EN London

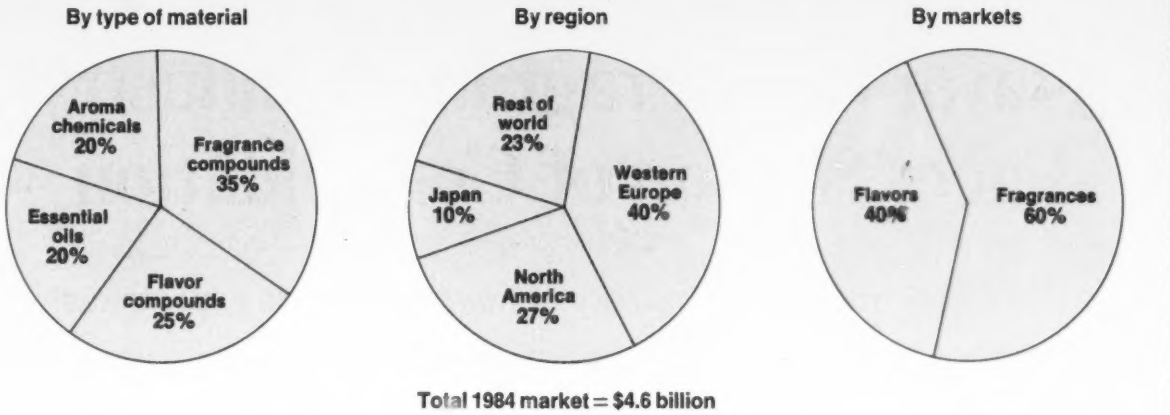
Earlier this month, the fifth largest flavors and fragrances supplier, U.K.-based PPF International, acquired the tenth largest, Norda, of the U.S. The combined company, a subsidiary of British-Dutch giant Unilever, will rank third in the worldwide industry. The acquisition confirmed one of the most persistent rumors circulating in the industry. It is also the latest in a series of mergers and acquisitions in that industry since the early 1960s—and the chances are good it won't be the last.

For an industry that historically has been burdened with praise, such as the cliché about "the sweet smell of success" often headlining stories, the world has changed. It's not that the business has collapsed, or that the major producers are going bankrupt—far from it.

But from the heady days of sales increases of 12 to 17% per year during the 1970s, growth has slowed significantly. Sales price erosion is cutting into suppliers' profitability. With increasing levels of customer service demands and demands posed by proliferating legislation, companies are having to increase their capital

Toiletries and household products provide huge market for fragrance chemicals

Balance characterizes flavors and fragrances industry's sales



Total 1984 market = $4.6 billion

spending and their R&D funding. And a continuing strong U.S. dollar is playing havoc with companies that must cope with currency exchanges.

Pressures like those weigh heavily on an industry that is particularly fragmented. The top 15 companies, worldwide, probably have just slightly less than 50% of the market; the remainder is shared by nearly 1000 other suppliers, many of whom sell to just one or two major accounts. As one market analyst notes, usually in an industry the top four or five companies account for about 40%; in the flavors and fragrances business, however, the top five companies have about 31%. Only about eight or nine companies have sales of more than $100 million per year.

That kind of competitive, fragmented environment has convinced some industry observers that no more than half a dozen major suppliers will still be in the business by the end of this decade. The medium-sized companies will disappear, they predict, merging together much as did four small companies in 1979 to form Universal Flavors & Fragrances, or as five small suppliers in Grasse consolidated into Sanofi, a subsidiary of French state-owned oil company Elf Aquitaine. Or they will be acquired by larger companies, as Norda has just been by PPF International. Or they will be bought by chemical or other companies, as BASF bought Fritzsche Dodge & Olcott in 1980, Hercules did with Polak's Frutal Works in 1973, or Union Camp did with Bush Boake Allen in 1982.

Typical of acquisitions outside one's area of expertise, sometimes they don't work out. For example, in 1968 Monsanto bought George Lueders, an essential oils supplier, expanded the business into Monsanto Flavor/Essence, and eventually sold it to Tenneco, which at the time owned Bush Boake Allen through its Albright & Wilson subsidiary. (Monsanto kept several commodity aroma chemicals, including ethyl vanillin.) Tenneco was just as uncomfortable in the flavors and fragrances business, and in 1982 sold the package to Union Camp—a sale that was almost universally welcomed at Bush Boake Allen.

What Union Camp believed it had going for it was an at least elementary knowledge of the industry through its terpene chemicals, many of which are used in the flavors and fragrances industry. That was a similar argument, for example, used by Hercules when it acquired Polak's Frutal Works in 1973. Hercules also was strong in such food additives as emulsifiers and thickeners and felt that the addition of Polak's Frutal Works' food flavors would help it round out its product line. And companies such as BASF and Bayer view flavors and fragrances as the higher-value extension of commodity chemicals they have long sold.

That's particularly true as synthetic chemicals have become an increasingly important part of the industry. Synthetics—from both petrochemical and natural (such as turpentine) raw materials—have become indispensable materials for the flavors and fragrances industry. They now account for more than 85% of the materials used in the fragrance side of the business. And even despite pressures brought by tightened regulations and consumerism, synthetics probably account for about 40% of the total flavors business, worldwide.

In terms of value, of course, synthetic chemicals have a smaller share of the market. But that is a reflection of the major selling point their suppliers make: Synthetics are cheap. There are some selling for what seems like a hefty tag, perhaps $25 to $50 per kg. But even double that would be far short of the inflated prices some of the rarer essential oils can bring—several thousand dollars per kilogram, for example, for Bulgarian rose oils. And the average price for the synthetics is actually closer to about $11 per kg.

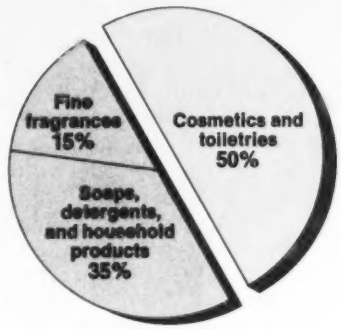
Aroma-chemical suppliers also point out that chemical synthesis is much more dependable than Mother Nature can be—synthetics aren't subject to the vagaries of weather, erratic crops, and lack of labor to harvest crops. And they undoubtedly get better throughput than some of the naturals—3000 kg of rose petals to give 1 kg of rose oil, for example.

Quantities also can be adjusted to reflect demand. Suppliers of synthetic aroma chemicals are fond of citing

vanilla, as a case in point. There isn't enough vanilla—the natural material from vanilla beans—worldwide to satisfy the demand for vanilla-flavored ice cream in the U.S. alone. Hence, the continued demand for vanillin, the synthetically produced major constituent of vanilla.

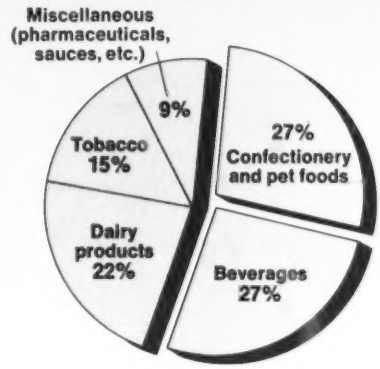
Vanillin, used as a flavor enhancer and smoother in the manufacture of chocolate, is one of the few aroma chemicals that is used as is. Menthol is another; besides being compounded into mint flavors, it is used as a flavorant for menthol cigarettes. Most aroma chemicals, however, are destined for compounding. Their availability is what has brought about the change from the flavors and fragrances industry of the past to that of the sophisticated present, albeit in two distinct directions—one of fragrances, the other of flavors.

Cosmetics, toiletries lead fragrance sales



1984 sales = $2.8 billion

Confections, pet foods, and beverages top flavor sales



1984 sales = $1.8 billion

Fragrances—perfumes—have been around as long as there have been people to enjoy them: first in religious ceremonies and in funeral rites, and later in other ways in day-to-day life. But, by and large, they tended to be the province of the wealthy.

Indeed, in the heart of the French perfume industry, Grasse, the essential oils processed there went into the finest and costliest of fragrances. However, by the end of the 19th century, organic chemistry was opening the door to wider markets.

The discovery of coal-tar-based solvents and the development of fractional distillation technology enabled researchers to isolate the various constituents of flower, drug, and animal essences which had been used as "givens." Constituents could be isolated, identified, and eventually reproduced synthetically, if for no other reason than to extend the availability of the costly originals to meet burgeoning demand. No longer needed were such time-consuming and enormously expensive techniques as enfleurage, whereby petals of the desired flower are laid on thin layers of purified fats, which eventually draw out and hold the small quantities of fragrance chemicals within the flower itself. Such techniques could still be used, and still are, for essences for premium-priced perfumes, but it was no longer a must.

That marked a dramatic change in an industry which earlier had been tied into the medicinal and pharmaceuticals fields. Aroma chemicals were first isolated and identified in the early 1830s, when European chemists identified cinnamic aldehyde from cinnamon oil, and benzaldehyde from bitter almond oil. After 1850, more and more similar synthetics became available: esters of low-molecular-weight acids and alcohols, methyl salicylate (artificial wintergreen oil), benzaldehyde, vanillin, and so on.

During the early part of the 20th century, however, the development of synthetics began in earnest, mirroring the rapid developments in the field of organic chemistry. For the aroma chemical researcher, it has become relatively easy to take a mixture, or compound, and eventually take it apart. From the total impression that the compound's odor or flavor gives, the researcher can proceed through distillation, for three rough separations. First taken off are the low-boiling-point materials, which give a compound its "top note." Next come off the medium-boiling-point materials, which are the "body" of the compound. That leaves the "bottom note" high-boiling-point constituents of the compound.

Volatility is, of course, the key to the success or failure of a flavor or fragrance material, and that is more or less dependent upon a chemical's molecular weight. For example, the simplest aroma chemicals are roughly C_6 to C_8, with the range of optimum performance C_8 to C_{16}. If the material is above C_{20}, the chances are it probably will not be volatile, hence not of use to the researcher.

And there is frequently a correlation between structure and fragrance or flavor—a fruity scent associated with an ester, for example. It is impossible to predict exactly what the scent will be, merely by looking at the structure. But the researcher will have a rough idea, which trial and error will help to establish more exactly.

Once the compound has gone through distillation, it then will proceed through chromatography. Column chromatography could be used, for example, to isolate apolar hydrocarbons and oxides from the semipolar aldehydes and esters, in turn, from the polar alcohols and acids. More frequently these days, however, researchers will go straight to gas chromatography to isolate single compounds, and to mass spectroscopy to identify the chemicals in question. Despite the mystique kept up about Coca-Cola's unique formulation, for example, it probably would be possible for a canny chemist to reproduce it. However, without the marketing backup, he or she would be left with just a jumble of materials. It takes marketing, with good-quality products, to carry a jumble of chemicals, as the French perfume industry found out after World War I.

The age of synthetics really arrived in the 1920s, with the introduction of Chanel No. 5 perfume, a concocted fragrance that perfumers describe as "aldehydic" in its nature. Its success signaled perfumers that they no longer had to imitate slavishly the scents found in the garden, using materials found in the garden. It became a matter of imagination and creativity to build complex, sophisticated new fragrances.

And with the rise of synthetically produced raw materials and building blocks, costs tumbled dramatically. Fragrances began moving from the world of crystal flacons into fine soaps and cosmetics, and eventually into the more humble world of everyday soaps, detergents, and other household products. In fact, in the fragrances world, synthetics now probably account for nearly 90% of the volume of fragrance materials being marketed.

In the world of flavors, on the other hand, the numbers are quite a bit different, and, indeed, some estimates hold that synthetically produced products have less than half the worldwide market. In developing-country markets, synthetics have about 75% of the business, natural products the remainder. However, in Western Europe and the U.S., those percentages are reversed. One estimate for Western Europe, for example, holds that of all flavor ingredients, 75% are naturally obtained, 24% are synthetically derived "nature-identical," and the remaining 1% truly artificial, not to be found in nature. In the U.S., the proportion of naturally obtained material is the same, but the other two are lumped together.

Many companies compete in global flavors and fragrances industry

	Owner	When acquired or formed
International Flavors & Fragrances (U.S.)	Independent	1958
Givaudan (Switzerland)	Hoffmann-La Roche	1963
Naarden (Netherlands)	Independent	1905
Haarmann & Reimer (West Germany)	Bayer	1954
PPF International (U.K.)	Unilever consolidation	1946/1960
Firmenich (Switzerland)	Independent	1895
Florasynth-Lautier (U.S./France)	Merger	1981
Bush Boake Allen (U.K.)	Union Camp	1982
Takasago (Japan)	Independent	1920
Norda (U.S.)	Independent[a]	1924
Dragoco (West Germany)	Independent	1919
Fritzsche Dodge & Olcott (U.S.)	BASF	1980
Universal Flavors & Fragrances (U.S.)	Merger	1979
Roure Bertrand Dupont (France)	Hoffmann-La Roche	1963
Polak's Frutal Works (U.S.)	Hercules	1973
Felton International (U.S.)	Independent	1922

a PPF International announced acquisition July 20, 1984. **Note:** Companies listed in descending order of sales of flavors and fragrances.

That highlights one of the major influences upon this segment of the industry: governmental regulations and the impact of consumerism, and the differences region to region. Flavor suppliers feel that the regulations governing how such chemicals are labeled, in particular, are more flexible in Western Europe than in the U.S., with its black-and-white differentiation between natural and synthetic.

European laws tend to recognize as "nature-identical" those synthetically produced molecules which are the same as those naturally obtained. For example, vanillin produced from lignin, the major synthetic source, is the same molecule as the vanillin isolated from vanilla extract, and should be so considered. In the U.S., however, it would be considered strictly synthetic, tarred with the label "artificial vanilla" on food-package labeling. Flavor-chemical suppliers say that synthetics had been making significant inroads into the U.S. market until about 10 years ago. Since then, however, and particularly over the past five years, the trend has reversed to naturally obtained flavor chemicals, as food manufacturers scurry to emblazon "natural" on their labels.

A trend toward "natural" also is beginning to develop in Western European markets, suppliers believe, and it may well start happening in the important Far East market.

There are several ways to look at synthetically derived aroma chemicals. One way is to categorize them by feedstocks. Terpenes, for example: extracted from essential oils, or derived from α- and β-pinene, for such aroma chemicals as terpinol, terpinyl acetate, dihydromyrecenol, geraniol, linalol, citral, ionones, and citronellol, important in itself and as a source of further derivatives. The terpenes also can be obtained by total synthesis, coming from production of raw materials otherwise bound for synthesis of vitamins A and E, for example.

Petrochemicals provide a somewhat broader line of aroma chemicals from simple benzene derivatives. Phenol, for example, yields amyl and benzyl salicylates, and, to a smaller extent, through guaiacol, vanillin. Benzaldehyde and toluene give amyl cinnamic aldehyde and benzyl acetate. Xylene is the primary source for musk xylene and musk ketone. That is a short list, only of the petrochemical contribution to the 3000 or so aroma chemicals used in compounding flavors and fragrances.

On the other hand, synthetically derived aroma chemicals can be clumped together broadly by structure. That's how Hans Daeniker, a consultant with SRI International in Zurich, for example, looks at aroma chemicals. As he sees them, there are four basic categories: benzenoids and naphthalenoids, which make up more than 50% of the volume and 40% of the value of aroma chemicals; monoterpenes, 20% of the volume and 30% of the value; musk chemicals, 2% of the volume and 7% of the value; and a miscellaneous category of other aroma chemicals, making up about 25% of both the volume and value of the market.

For Daeniker, one of the most striking—and worrying—aspects of the present state of synthetic aroma chemicals is the general age of the chemicals. As he

pointed out in a discussion on the subject at a conference on specialty chemicals in Monte Carlo last month, "Most of the big-volume aroma chemicals have been in use for 20 years or more. Very few new ones have been added lately." This is of concern, he says, because there is little patent protection left—an invitation for more manufacturers, lowered prices and thereby lowered price margins—and there is little left that a supplier can do better in terms of process improvement for any given chemical than its competitors have done.

This is despite the relatively high amounts of R&D money that major suppliers in the business spend. Givaudan, for example, budgets 7 to 8% of annual sales on R&D, roughly split evenly between applied and basic molecular research. Firmenich, which is privately held, has said in the past that it spends 12% of its sales on basic and applied research. Other major suppliers say that those percentages are typical for their industry. The smaller the company, of course, the less it spends on research and development. Nonetheless, the flavors and fragrances industry as a whole spends a sizable proportion on R&D—perhaps not so much as the pharmaceutical industry, but certainly more than the basic chemical industry.

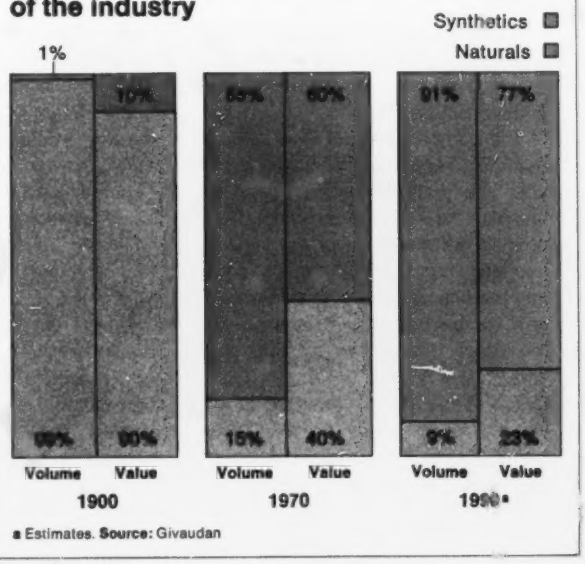
So why so little to show for the effort? Daeniker figures there are four major reasons. First, he says, companies have concentrated on process technology, rather than new chemicals per se, improving process-engineering economics—various processes for making monoterpenes from pinenes, for example, or the synthesis of L-menthol. Second is a certain saturation of the market. "A good new product could find a market, but it is not badly needed," he says. There is already a large pool of chemicals from which to draw, with ready availability and reasonable prices. Thus the compounder already has almost unlimited possibilities for new combinations for new and original flavor and fragrance compositions.

Another reason is that many of the materials that have been introduced over the past two decades have been specialty materials that will replicate the trace components of naturally occurring flavors and fragrances. They have been analyzed, synthesized, and made available to the compounder for use, in trace amounts, to give a special effect to a composition. The trace amounts used help overcome the handicap of low volumes and often high prices. Large chemical manufacturers are not interested in this field, Daeniker says, and they leave it to the flavor and fragrance producers, or to small specialized chemical companies.

However, perhaps the overriding reason has been the increasing legal and toxicological requirements being imposed by various governments, particularly for new flavors and fragrances that will not be covered by any grandfather clause provisions. Moreover, in the flavor field, the demand by the public and politicians for natural products has retarded chemical research.

The industry, conscious of the increasing burden it would bear, and of its responsibilities as supplier, established in 1966 the International Organization of the Flavor Industry, and in 1973 a sister organization, the International Fragrance Association, to establish guidelines concerning safety aspects of the use of its raw

Synthetics have swept into control of the industry



materials and products. Both these associations, served by effective technical advisory bodies, are based in Geneva, and work closely with the U.S.-based Research Institute for Fragrance Materials (RIFM). RIFM depends for its judgments on an independent panel of international experts who study such topics as toxicology, pharmacology, and dermatology. The two Geneva-based associations, on the other hand, tend to concentrate on the legal side of things. Through their member national associations, they maintain contacts with governments, the medical profession, and so on, helping to guide their members and to contribute to the preparation of legislation.

For an industry in which commodity status easily can be reached at 1000 tons per year worldwide, and in which many more materials are sold in less-than-ton quantities, the costs for legal and toxicological tests are becoming prohibitive for much new-product development. In some respects, the testing is similar to that for pharmaceuticals, particularly for aroma chemicals destined for flavors. Even if it isn't quite so intensive or rigorous in the long run as that for pharmaceutical testing, the costs for aroma-chemical testing can mount up. And the thought of spending tens or hundreds of thousands of dollars on testing a material that may sell only several tons a year, worldwide, gives a board of directors pause. It is very hard, in fact, to predict if a material will even make it into the tonnage category, or will just stay at 100 kg per year—a not unusual market size for many fragrance and flavor materials.

In fact, if anything, the trend is toward a simplification of perfume formulas. Of the 3000 or so aroma chemicals used in compounding flavors and fragrances, about 20 are used in quantities greater than 1000 metric tons per year. Another 40 are used in quantities between 100 and 1000 metric tons per year, 60 between 10 and 100 metric tons, and about 250 between 1 and 10 metric tons. All the

Compounding is the name of the game

In the flavors and fragrances industry, compounding is the name of the game, the most important area for companies in the business.

The compounder will start with raw materials—essential oils, and aroma chemicals both synthetically produced and also derived from essential oils. A product, a scent or flavor, is then compounded that, when eventually mixed into the finished product, will either be new, or be better or less expensive (preferably both) than existing products.

In a sense, the compounder is middleman for a variety of populations. Unless the compounder is backward integrated, for example, into essential oils, it buys from a host of smaller agricultural producers or state-run cooperatives. And, again depending upon the degree of backward integration into basic chemicals, the compounder will make its own aroma chemicals or buy them, often from competing suppliers. It then bridges the gap between basic raw materials and finished consumer products with its own compounds, which can be as little as 0.1% of a product yet be a crucial ingredient.

Some customers are giants who will buy only that compounder's aroma chemicals to do their own compounding—manufacturers such as Procter & Gamble, Colgate-Palmolive, and Henkel, for example, or food processors such as General Foods and Coca-Cola, with its original formula.

Other customers, however, will bring the supplier a brief to compete on, about the product desired. Sometimes it's a revamp of an existing product—the desire to be able to label "new, improved flavor," or "new, lemon-scented." More challenging to the supplier, however, is the new-product brief. For the flavorist, it is perhaps the opportunity to develop a new flavor that will withstand the rigorous production conditions by which a new extruded soy-protein snack will be made. For the perfumer, it might be the assignment of designing a fragrance and then making sure that it, or slight variations on it, will be suitable to also incorporate into matching soaps, shampoos and conditioners, skin creams, and lotions.

Moreover, it all has to be done with great discretion. The marketing mystique would be shattered by the public's awareness that this or that haute-couture designer is really just peddling a fragrance that a supplier developed. Although such enforced anonymity might be frustrating to perfumers and flavorists, they are comforted by knowing that in this small, intensely gossipy industry, the people who really count—their peers—know who has done what. And although fine perfumes are only about 15% of the fragrances business, for example, and a fairly small segment of most suppliers' sales, they are worth the effort because of image. A supplier that has had one winner will have more offers from customers to compete on the next project because of the enhanced reputation.

rest are used in quantities less than 1 metric ton, with many less than 100 kg per year.

Customer services also are becoming increasingly expensive. At one time, flavor and fragrance suppliers provided little beyond the compositions and chemicals needed for their customers' products. But that situation is long gone. Only rarely, say suppliers, are they the last to know what is happening in terms of product development. Only rarely, for example, will a food manufacturer design and develop a product only to think at the last moment, "Ah, yes, this must have an apricot flavor."

Much more commonly, flavor and fragrance suppliers will carry out their own research on such applied chemistry as skin cream emulsions, the effect of aerosol propellants on fragrances, fragrance substantivity for household detergents, and so on.

They are studying the legal requirements for their materials around the world, and generally can advise their customers as to what will be acceptable and where. Haarmann & Reimer, for example, has a data bank of the flavor substances it uses, worldwide, including available names, pharmacopoeia listings, legal requirements, and so on. It took the company 30 manyears to set it up, its directors say, and two chemists and 10 assistants work on it to keep it continually up to date.

Companies also are becoming far more marketing oriented. As the current jargon puts it, they are becoming marketing-driven, rather than technology-driven. At one time, says one company marketer, suppliers simply created fragrances and flavors and sold them. Now, they do extensive consumer-market research—what are consumers buying, and what will they be buying a year or two from now? What forms will the products come in? Where will they be sold, both in what countries and through what kind of stores and shops? What differences are there, country to country, region to region? Such market research probably wouldn't stop a marketer bound and determined to introduce a particular product into any given market, even if it was unsuitable—but it would reinforce the analysis and decisions taken by prudent marketers.

It is becoming increasingly difficult for smaller companies to give that kind of service, or even for medium-sized suppliers, who are being pressured to give more service.

Because larger companies can afford the R&D to improve process efficiencies and trim their own costs, the smaller firms also are bearing the brunt of generally low price margins which have been dogging the industry lately. Moreover, because the flavor and fragrance industry is fragmented, it has not been able to pull much bargaining weight with the giant customers it supplies in the largest fields.

Soaps and detergents, for example, are dominated by just a handful of international majors, who are determined to keep down the prices of their raw materials, as do companies such as Avon, L'Oreal, and Revlon in the cosmetics and toiletries field. Selling prices haven't kept up with other increases, suppliers say, and are certainly

not at the levels that would be needed to justify building replacement or new capacity.

The result may well be a growing polarization of the industry between very large (probably not independent) suppliers and very small ones who sell to just one or two clients in a business area they know well and which isn't changing rapidly.

Larger, outside companies that decide to buy into the business should be aware of such trends, suppliers warn. They also should be aware that growth, although real (probably real growth of 3 to 5% per year through the rest of the decade), is nowhere near the former glory days, with high apparent growth rates.

A decline in the apparent rates has been caused, ironically, by the success of synthetics, some marketers contend, and by the ways available to chart the success of the industry. There are little hard data on the industry. Most of its compounds, for example, are tucked neatly away in the "miscellaneous" categories of data such as the synthetic organic chemicals statistics in the U.S.

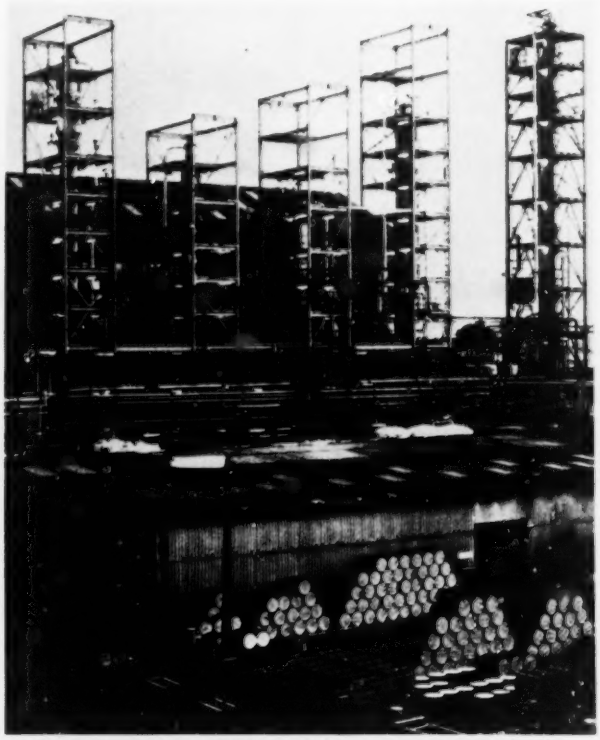
So what analysts tend to do is look at the sales of the companies in the business, both those that are published, and those that must be estimated from within corporate totals or from privately held secrecy. There is always some double-counting in the sales. For instance, if Fritzsche Dodge & Olcott processes its own essential oils and uses them in a fragrance compound that it sells, that is invoiced only once. But if it sells the essential oils to Givaudan, which in turn incorporates them into its fragrance compounds for sale, the essential oils would be invoiced twice. If the double-counting is done consistently, one can read a pattern over the years.

However, earlier there was not so much cross-selling in the industry. Smaller suppliers, in particular, would make their own products, mostly based on essential oils, for sale—one invoicing. Over the past 10 to 20 years, however, as synthetics became overwhelmingly dominant, smaller suppliers began turning to outside suppliers in much greater degree—an increase in double-invoicing. No more was being used, although more was being sold. According to some industry marketers, that gave the industry an artificially inflated apparent growth rate which has now slowed down, as the shift from own-manufacturing to buying in has been more or less completed.

Nonetheless, companies in the business are optimistic about it. They see their success coming from studying the market to find where the new-product opportunities are—for example, in new room and environmental fresheners, or in new food sensations, such as the recent U.K. hit, "hedgehog"-flavored potato chips; in doing what they are doing, better.

Companies also can benefit by spotting changes in existing markets and developing the products required. For example, the continued development of new detergent-based systems means that aroma chemical suppliers must continually be monitoring stability characteristics and revamping their formulations and compounds.

And flavor and fragrance suppliers also can be winners by keeping an eye on the Far East, which is the fastest-growing market for their materials, with an estimated growth rate of 8 to 15% per year through the rest of the decade. Helping to explain the high growth is that consumption is still low—value of about 50 cents per capita of flavors and fragrances, compared with nearly $5.00 per capita in both Western Europe and North America. And as the general economic conditions in a region improve, as they have in the Far East, manufacturers of consumer products can upgrade the ingredients they use for sale to consumers who are able and willing to pay for better-quality products.



Bush Boake Allen's Wildnes, U.K., aroma chemicals plant

"It doesn't need much in terms of an increase in disposable income to want the better things in life, after basic needs are satisfied," says SRI's Daeniker. "In the beginning, they will be satisfied with something cheap, then people will want something better. Flavors and fragrances make up only a few per cent of the total cost picture of consumer products, but the degree of success or failure for a product is much higher, because of the flavor or fragrance."

As Laszlo Unger, economist with Givaudan's strategic planning unit, puts it, "The better-positioned companies in the 1980s will be those that have integrated modern corporate management practices with traditional creativity in basic chemical research, flavor and fragrance ingredient compounding, and product development." That presupposes, he adds, "a flexible management, an independent and innovative group of creators, and a profound understanding of consumer and industrial marketing techniques as well as the needs of consumer-oriented companies." There—as easy as putting together the scent of a Mr. Lincoln hybrid tea rose. □

Mineral-Based Inorganics Struggle out of Recession

Production will increase notably this year for lime and sulfur but only marginally for potash and phosphorus

Bruce F. Greek, C&EN Houston

Along with some recovery in production, a little optimism has returned to producers of four of the largest-volume mineral-based inorganics—lime, sulfur, potash, and phosphorus. But production of all four is still well below their historic highs. Some may never again reach previous record highs because of special circumstances in their production worldwide or in their uses in the U.S.

Each of these four major-volume inorganics differs in its recovery pattern from the past recession. Lime, for example, may have a production gain of 11% this year over 1983, but potash production at best will be flat or up just slightly. But lime's 11% gain—the largest gain forecast for any of the four inorganics—is very close to the average annual increase expected this year for all major-volume chemicals.

The lack of big growth typifies the position of the mineral-based inorganics—that of mature products. They are continuing to be beset by competition in their markets from other chemicals, by imported derivatives and products made using these inorganics, and by the resulting pressures on prices and profitability. For most of these, capacity is declining as marginal units are shut down.

Key Chemicals

But what capacities are declining is difficult to say, because getting a good fix for this group is not easy. Lime kilns, for instance, vary widely in size, and production rates depend on the kinds of limestone used and product lines.

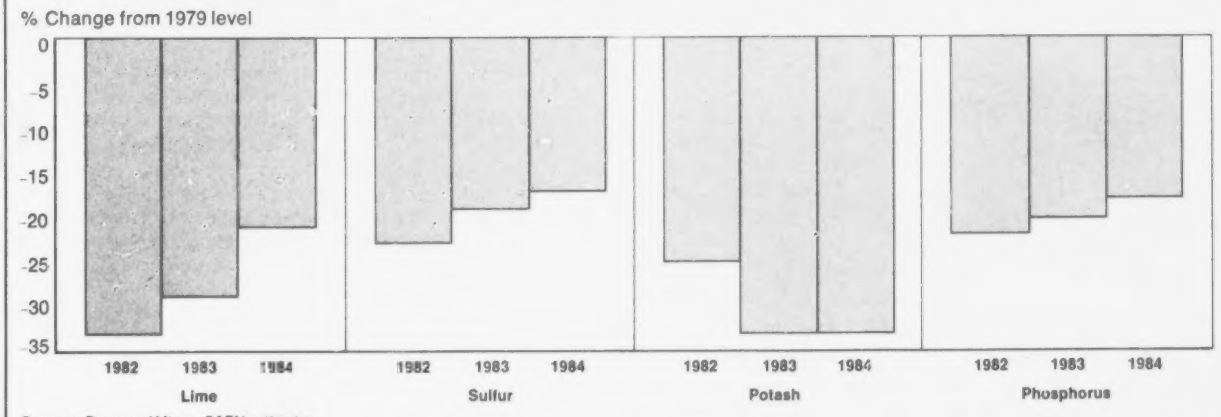
Estimating sulfur capacity has similar difficulties. For recovered sulfur, capacity has to be large enough to handle all sulfur that might come to the plants. But often the sulfur contents of crude oil and natural gas fed to refineries and to gas processing plants fall well below expected contents on which designs are based, making capacities much larger than needed.

For New Mexico potash producers, capacity is influenced by the average potassium oxide content of ores. The ore grade has been declining slowly in recent years about in line with forecasts of the life of the potash deposits. Capacity may be understated as a result of the decline in ore grade.

And similar to potash capacity, phosphorus furnace capacity assumes a phosphorus content in the rock fed to the furnaces. But, the decline in phosphate rock quality apparently has had little effect on capacity.

For details of the near-term outlook for these mineral-based inorganic chemicals, please see the following pages.

Output of mineral-based inorganics remains below prerecession levels



Sources: Bureau of Mines, C&EN estimates

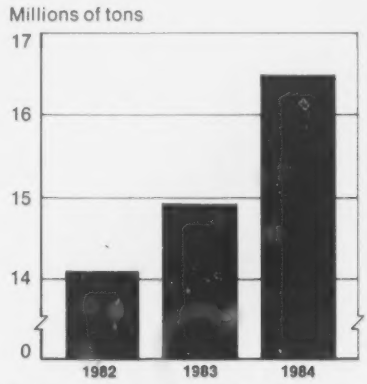
Key Chemicals

CaO-MgO

Lime

- ***Demand well up***
- ***Capacity excessive***
- ***Prices still weak***

PRODUCTION



Note: No capacity estimates are available.

HOW MADE

Calcining limestone (mainly $CaCO_3$) to make quicklime (CaO–MgO), then adding water to make hydrated lime, $Ca(OH)_2$

MAJOR END USES (U.S.)

Metallurgy (mainly steel flux) 45%, sewage and pollution control 15%, chemicals 10%, potable water treatment 10%, construction 5%

FOREIGN TRADE

Exports—less than 25,000 tons in 1984, imports—declining, 250,000 to 300,000 tons

PRICES

$45 to $55 per ton, depending on volume, location, and other conditions; discounts still significant

COMMERCIAL VALUE

$800 million for production, 1984

Lime production shows gains that fit the expected recovery from a difficult recession. Production in 1984 will be up 10 to 12% from 1983 to about 16.5 million tons.

That growth would seem to be substantial if compared to 1983's 6% gain over 1982. But these gains are relatively small compared to the very large declines in production following the historical production peak of almost 21 million tons in 1979. In effect, 1982's production of just over 14 million tons was down a third from the 1979 high.

No capacity estimates are available for lime. Production is divided between merchant and captive producers with about a quarter of production used captively. Both kinds of producers apparently are reducing capacity, however, as fewer producing plants are reported each year.

Energy is a big factor in the decision to scrap capacity. Lime requires relatively high amounts of energy for its manufacture, averaging more than 6 million Btu per ton of product. In spite of some improvements in designs to improve energy efficiencies and a major shift to use of coal as the fuel, some lime kilns with unfavorable combinations of energy cost, location, physical properties of the feed limestone, and end-use requirements are shut down from time to time. How many of these kilns are down at any one time depends on all these factors as well as current demand and price. Some kilns may remain inoperable for years before being restarted, but others become impractical to restart, especially with present lime selling prices.

Until the most recent recession, lime consumption grew slowly, as would be expected from a mature large-volume product. Most of the growth in volume came from the steel industry as it shifted over to basic oxygen and electric furnaces from open-hearth furnaces. The base for use of lime in metallurgy was large, making the fractional growth of this use lower than some of the newer uses such as stack gas scrubbing to remove sulfur gases. The big reduction in steel manufacturing caused by both the recession and a surge in imports of steel badly hurt demand for lime in metallurgy.

Now with the steel industry rebounding to meet demand by the auto and other industries, lime demand also is coming back. In 1984, lime going just to the steel industry could total 6.5 million tons if steel production reaches 100 million tons as forecast. This follows the rule of thumb that 6.5 lb of lime are needed as fluxing material per 100 lb of finished steel. This use alone would require 40% of lime production this year.

Use of lime in processing ores such as bauxite for aluminum production and ores of copper, tungsten, and uranium could add another 1 million tons to 1984 demand for lime. These nonferrous metal uses could then bring the total for all kinds of metallurgical uses to around 45% of total lime consumption this year.

Environmental uses of lime rank next in size. These uses cover a broad spectrum, ranging from scrubbing to various kinds of water treating. They likely will total 3.5 million to 4 million tons of lime in 1984, or nearly 25% of consumption.

Use of lime for scrubbing to remove sulfur gases passed the 1 million ton level in 1983 as forecast, but just barely. This use was up about 2% last year and probably will be up even more in 1984, as additional scrubbers are started up. The key to future use of lime in scrubbing, however, depends on legislation concerning acid rain. A host of yet-unresolved questions make forecasting lime demand in scrubbing difficult. For example, the new limestone injection multistage burner (LIMB) now appears experimentally to do a better job if hydrated lime is substituted for limestone. Also, the Environmental Protection Agency is pushing for a requirement that all new sources of sulfur gases must have some kind of scrubber to minimize pollution.

In the field of scrubbing, the dry technologies now go mainly to the use of lime as the reactant to take out the sulfur gases. Wet scrubbing usually uses limestone.

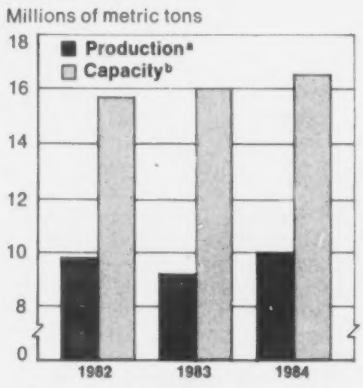
Most other uses of lime such as in construction, pulp and paper manufacture, potable water treating, and sugar beet processing, will show small gains, if any, in 1984.

Sulfur

S

- ***Demand improved***
- ***Capacity up some***
- ***Prices may rise***

PRODUCTION/CAPACITY



a From all sources. b As of first quarter; includes more than 5 million metric tons of standby capacity at smelters and recovery plants.

HOW MADE

Recovered from sulfur compounds processed in refineries, natural gas processing plants, and smelters; melted from underground deposits

MAJOR DERIVATIVES (U.S.)

Sulfuric acid 90%, chemicals 5%

MAJOR END USES (U.S.)

Fertilizer 60%, chemicals 20%

FOREIGN TRADE

Exports—holding at about 1 million metric tons in 1984, imports—rising, may exceed 2.25 million metric tons

PRICES

$130 per metric ton at Tampa, Fla.

COMMERCIAL VALUE

$1.25 billion for production, 1984

Sulfur producers have a good chance of getting back over the 10 million metric-ton-production level this year. And if they do, it will mean that production of sulfur in all forms will be up 7 to 8% from last year's levels. This improvement contrasts favorably with the 5% decline in production during 1983.

But even at the 10 million metric-ton level, production still would be more than 17% less than 1981's peak of 12.1 million metric tons. It probably will take several more years to set a new output record. The economic recovery plus the changes in farm policies will account for most of the gain in sulfur production by providing a good shot in the arm for demand this year.

Sulfur capacity will continue to rise as well during 1984. When averaged out over recent years, capacity to produce sulfur rises about as fast as does production and stays far ahead of output, giving chronically low capacity utilization rates. The reason for this is that new plant falls into the category of "must" capacity; that is, capacity installed to remove sulfur as a coproduct from natural gas and petroleum products and to avoid pollution by sulfur derivatives. Often this "must" capacity is "spared," or overbuilt, making it perhaps twice as large as actually needed. This is done to allow continued operation of the plants making wanted products even if the sulfur recovery units were to have mechanical problems.

Because of the "must-be-recovered" sulfur output, Frasch sulfur production acts as the swing production. Frasch sulfur, produced by pumping heated water into underground formations to melt the sulfur and lifting it to the surface by air pressure, has fallen nearly 50% since 1981, dropping to 3.20 million metric tons from 6.35 million metric tons.

Shipments of Frasch sulfur, however, did not fall quite so fast. They were 900,000 metric tons above production in 1983, after being below production in 1981 and 1982. Frasch sulfur producers obviously cleared out some of their inventories during 1983. At the end of 1983, inventories of Frasch sulfur were down to a bit more than 3 million metric tons, about 100,000 metric tons more than they were at the end of 1980, another year of low inventories.

For 1984, Frasch sulfur production has been forecast to rise to about 4 million metric tons. Some Frasch mines were shut down during the past year, reducing operating capacity. And one mine will been scrapped this year, again reducing actual capacity by a small amount. This loss of capacity probably will be more than offset by additional recovered sulfur capacity. Even so, enough Frasch capacity is running to hit easily the 4 million metric-ton mark.

Exports of sulfur in 1984 will hold at about 1 million metric tons, about what they were during the past two years. Slightly lower exports from Gulf Coast ports probably will be offset by higher exports of recovered sulfur from the West Coast.

Imports of sulfur, almost entirely from Canada and Mexico, will run as much as 2.25 million metric tons up from almost 1.7 million metric tons in 1983. Canada might be the source of 1.6 million to 1.8 million metric tons as production does well there. Mexico might ship as little as 400,000 metric tons, but probably more, as problems hold down production and aboveground stocks are low.

Consumption of sulfur in the U.S. has increased 10 to 12% over the estimated total for 1983 of almost 11 million metric tons. Consumption in 1984, however, is not expected to be back at the 1981 level of 12.6 million metric tons. The additional increase in consumption over production will come from imported sulfur from Canada, which also will make up for a small decline in imports from Mexico expected this year.

As might be expected with the forecast consumption increase, prices for sulfur also have been firming. An increase in the price at Tampa of $7.50 per metric ton apparently has held even though many phosphate fertilizer units are down for their annual maintenance turnarounds. Rumors also persist in the industry that another $5.00-per-metric-ton increase in price will be tried in September at the end of the third quarter.

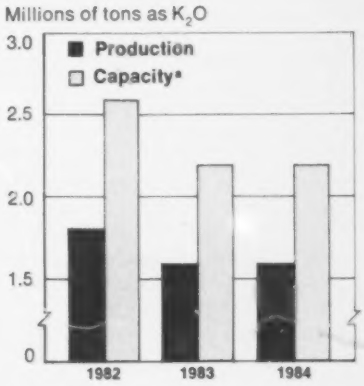
Key Chemicals

Potash

KCl, K_2SO_4, $K_2SO_4 \cdot 2MgSO_4$

- ***Demand holding***
- ***Capacity steady***
- ***Prices weakening***

PRODUCTION/CAPACITY



a As of first quarter.

HOW MADE

Shaft and solution mining of potassium salts, mainly the chloride, and subsequent purification

MAJOR END USE (U.S.)

Fertilizer 95%

FOREIGN TRADE

Exports—falling to about 300,000 tons in 1984, imports—rising to 5 million tons or more

PRICES

$101 to $109 per ton of K_2O equivalent; discounts heavy

COMMERCIAL VALUE

$150 million for production, 1984

Potash holds an unusual—some might say enviable—position among most major-volume chemicals. It is one of the few whose demand exceeds U.S. production by several times, most recently fourfold.

Prospects are that for 1984, potash production will about equal that of 1983 at about 1.6 million tons as K_2O. (Most potash is sold as the chloride, with smaller quantities as sulfates. For uniformity in reporting, production, sales, consumption, and other statistics are given as the oxide.) This year's production will be down about 11% from 1982 production, following a pattern of falling production in recent years.

Potash consumption in the U.S. is expected to be up a sizable amount in 1984 for the usual reasons—better fertilizer demand as a result of the end of the payment-in-kind crop set-aside program; better feed grain prices, especially for corn; and some lower crop carryovers. Apparently, crop losses due to flooding in the Midwest this spring will not be large enough to trigger many low-cost disaster loans that would help future fertilizer demand.

For the first five months of the year, potash consumption ran about 8% higher than for the same period of 1983. If this consumption rate sets the pattern for all of calendar 1984, then consumption for the year will be between 6.1 million and 6.2 million tons.

The big gap between consumption and U.S. production is made up by imports, mostly from Canada. In 1983, imports accounted for close to 75% of consumption, a new high in recent times. Imports also offset U.S. exports of about 375,000 tons, which go mainly to Mexico.

Inventory building could account for part of the expected higher potash consumption in 1984. (Consumption is considered to occur when potash moves from the mine or import site.) Inventories are increasing this year in hopes that demand will surge strongly again this fall as it did in the latter part of last year.

But the inventory situation could be a reason for the recent list price cuts of about 10% for the July-August period. These price cuts are scheduled to end in September, according to several producers, as the fall fertilizer season begins and a better idea of fourth-quarter fertilizer production develops.

Inventories are up now and some mines and mills are taking the usual extended shutdowns for maintenance and vacation. This occurred last year during the slump in fertilizer demand when some of the shutdowns were long enough to bring formal announcements from companies to make clear that a permanent shutdown was not planned. The current shutdowns will go a long way, however, in helping to reduce stocks.

Even with the inventory reduction under way, prospects are not good for much increase in U.S. potash production. Adequate capacity remains to handle increased demand, but lower shipping costs on top of lower production costs make more imports likely during the rest of 1984 and on into 1985. New Canadian mines in the New Brunswick area probably can put potash into market areas all along the East Coast at lower net cost than can mines in New Mexico.

About 95% of potash consumption in the U.S. goes to fertilizers, with practically all the rest going to make various potassium chemicals. More than 80% of the potash used as fertilizer is the chloride with the sulfate and magnesium sulfate accounting for all but a small part of the remainder. Special crops get the sulfate forms and some few crops, most notably tobacco, get the small amount of potassium nitrate that is sold as fertilizer.

Concern arose last year over some New Mexico potash mines that might be classified as mines containing enough methane in their atmosphere to require special equipment and operating techniques. Cost of such equipment and operations probably would have led to closing of the mines. Such a classification didn't occur so the mines are in a category that requires very little additional capital.

These kinds of potential added costs combined with new low-cost production in other places, especially Canada, pose a continuing threat to U.S. potash production. Thus, prospects are good for more capacity reduction such as occurred in 1982 during the first major production decline.

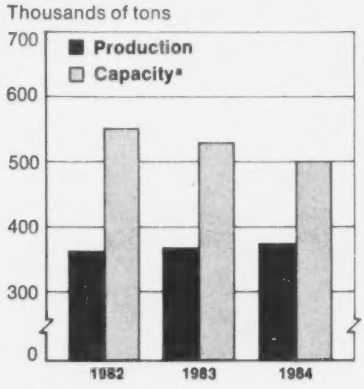
Key Chemicals

Phosphorus

P_4

- ***Demand up slightly***
- ***Capacity down***
- ***Prices steady***

PRODUCTION/CAPACITY



a As of first quarter.

HOW MADE

Reduction of phosphate rock in electric furnaces with carbon (coke) and silica as acids

MAJOR DERIVATIVES (U.S.)

Phosphoric acid and derivatives 85%, other chemicals 10%

MAJOR END USES (U.S.)

Detergents 45%, metal treatment 15%, foods and beverages 10%, chemicals 10%

FOREIGN TRADE

Exports—may reach about 20,000 tons in 1984, imports—negligible

PRICES

90 cents to $1.00 per lb

COMMERCIAL VALUE

$700 million for production, 1984

Phosphorus continues to face difficult times. Production in 1984 will be up just modestly, with capacity slipping down another notch.

The production numbers for recent years tell the tale of no growth for phosphorus. If all goes as expected in 1984, meaning no additional major reformulations of detergents, phosphorus production will rise 2 to 3% to about 375,000 tons. That would follow a rise of a bit more than 1% in 1983 from 1982 production, which fell more than 15% from 1981. In effect, then, the production recovery from the recession will be about a quarter of the decline.

Production capacity for elemental phosphorus has fallen in line with forecasts of little or no growth in output. Considerable capacity has been carried as installed capacity but not operating, and some of this capacity had been shut down as long ago as the late 1970s. Now industry sources do not expect any of the shutdown capacity located in Florida to run again. This is because of the higher electric power costs there than in the other elemental phosphorus producing locations in Tennessee and the Northwest. However, capacity in Tennessee also has been declining this year.

Because of the unlikelihood of the Florida plants' ever running again, revisions to C&EN's capacity estimates have been made to account conservatively for the shutdowns. About 25,000 tons of capacity were down before 1982, and about the same amount came down apparently permanently in that year, too. An additional 50,000 tons of capacity in Tennessee has been closed since the beginning of 1984.

For most of 1984, the total capacity available to produce phosphorus will be about 450,000 tons. This should bring the operating rate for the remaining capacity to about 83%, a much more desirable level for electric furnace plants, which represent high capital investment.

The revisions to phosphorus capacity to account for the long-shutdown plants clearly suggest that prospects for expansion are about nil. Both high investment and operating costs coupled with some decline in demand for phosphorus derivatives and pressure on prices of the derivatives also make building new furnaces very unlikely. Most large-volume derivatives of phosphoric acid that are made by burning elemental phosphorus and adding water, such as the sodium phosphates for detergents, can be made from wet-process phosphoric acid at costs that likely are lowered by the high depreciation charges of a new electric furnace. Even now considerable detergent phosphate materials are made from wet-process phosphoric acid.

Detergent phosphate materials, mainly sodium tripolyphosphate, account for a bit less than half of elemental phosphorus consumption in the U.S., down from more than 60% of consumption 15 years ago. Because of bans on phosphates in detergents in some communities, demand for phosphates that eventually wind up in detergents continues to decline. Bans have been effected, taken out, and then reinstated in some states. Other states may join in banning phosphate materials in detergents this year or later.

At the same time, reformulation of detergents could reduce demand for phosphate materials and, in turn, elemental phosphorus. Such factors leading to reduction in phosphates in detergents include growth in consumer use of liquid formulations, a trend toward lower washing water temperatures, and more use of zeolite builders in formulas

Offsetting slightly the negative factors in detergent and cleanser use of phosphate materials is the population growth. Consumption growth of detergents follows quite closely a fixed per-capita relationship. Thus, demand growth related to relatively small population increases will not offset, in terms of phosphorus use, bans on phosphates in detergents in states with large populations nor will it offset reformulations for whatever reasons.

The many other uses of elemental phosphorus are each a third or less the size of detergent and cleanser demand. Only one—metals treating—is showing much life this year, and this because of the recovery in durable goods, especially auto production. This includes both aluminum polishing and phosphate coatings as paint bases.